Consistency in trophic level (TL) normalised Hg concentrations among and within monitoring species – a pilot study

Caroline Ek, Sara Danielsson, Elisabeth Nyberg, Anders Bignert

Caroline.ek@nrm.se

Outline

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- Swedish Marine Contaminant Monitoring Programme (SMCMP)
- Normalisations according to the Marine Strategy Framework Directive (MSFD) / Water Framework Directive (WFD)
- Evaluation of consistency in TL normalised concentrations
  - Intra- and interspecies variation

SMCMP

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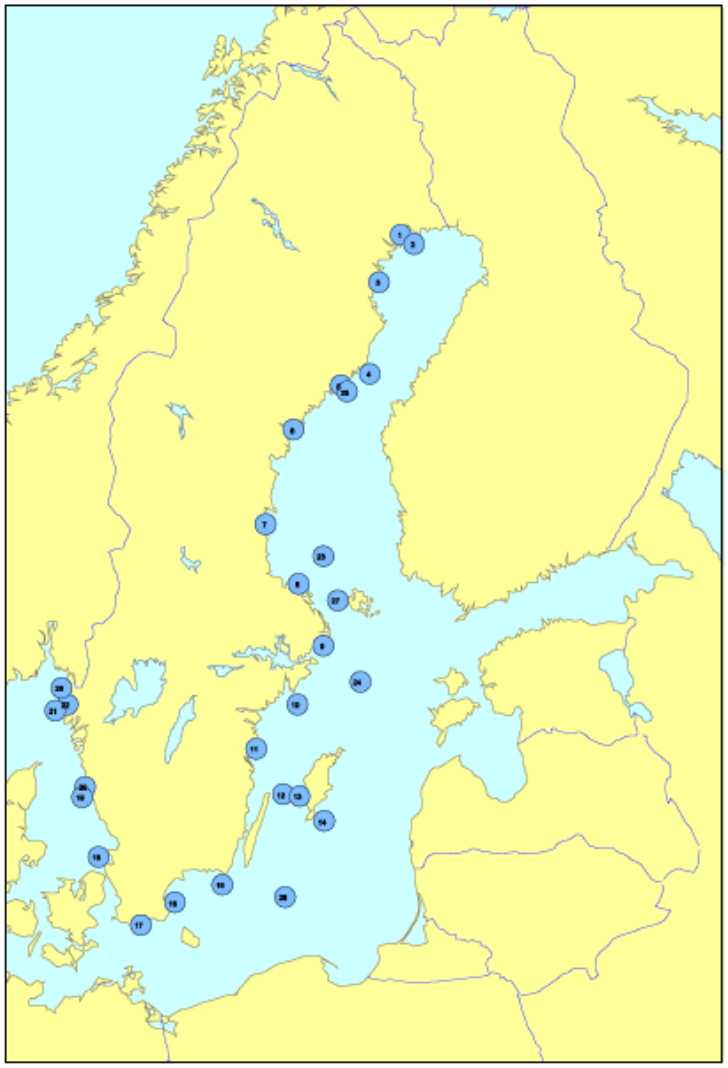
- Objectives
  - To indicate large scale spatial differences
  - To monitor long-term time trends and to estimate the rate of changes
  - **Assess contaminant status by checking compliance with target values (Quality Standards)**



TL adjustment of data: $EQS_{biota/hh}$

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- Recommended by the Water Framework Directive (WFD)
  Guidance Document No. 32

- Goals
  - To protect the most sensitive organisms from adverse effects from secondary poisoning
  - To reduce natural variation
  - To allow for a wide range of monitoring species between member states

- $EQS_{biota/hh}$ set to protect the most sensitive organisms
  - Freshwater food webs: TL = 3.5
  - Marine food webs: TL= 4.5
  - Human consumption: TL=4

Normalisations for Hg

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Adjustment to TL:

$$[C]_{TL} = [C]_{meas} \times TMF^{(TL_{EQS} - TL(x))}$$

Adjustment to dry weight, (DW, %):

$$[C]_{DW} = [C]_{meas} \times \frac{26\%}{DW(x)}$$

Combined adjustment to both TL and DW:

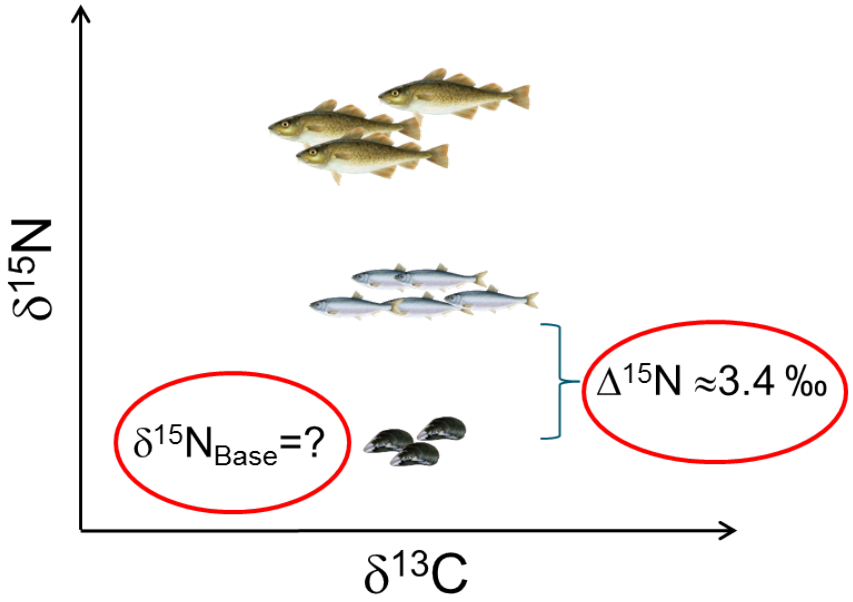
$$[C]_{TL+DW} = [C]_{meas} \times TMF^{(TL_{EQS} - TL(x))} \times \frac{26\%}{DW(x)}$$

Trophic Positioning (TP)

- Stable isotope analysis (SIA) of N and C (δ^{15}N and δ^{13}C).

- Requires knowledge of
  - Baseline δ^{15}N
  - Trophic shift (Δ^{15}N)

$$TP = \frac{\delta^{15}N_{Cons} - \delta^{15}N_{Base}}{\Delta^{15}N} + TP_{Base}$$



TMF → TL Normalisation

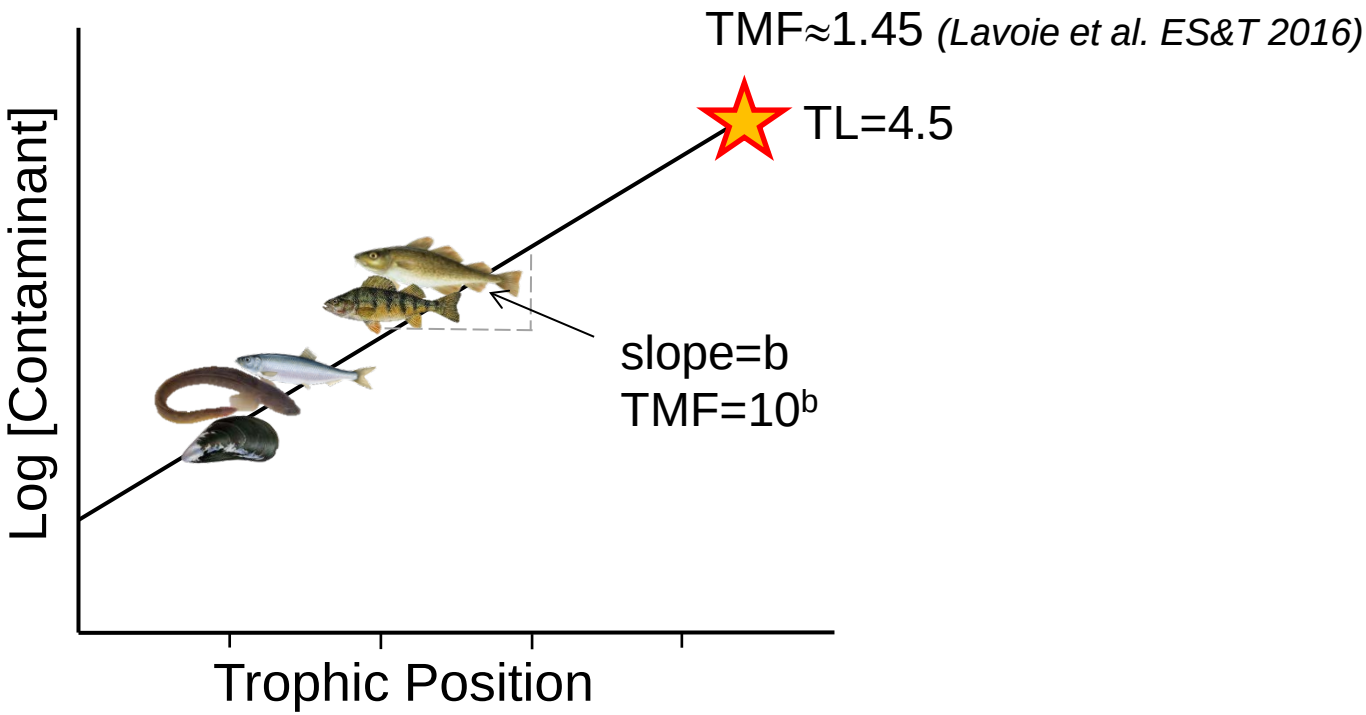


Figure references: Blue mussel, msc.org; Eelpout, zenscience.org; Cod, msc.org; Perch, maine.gov; Herring, msc.org

Choice of study area

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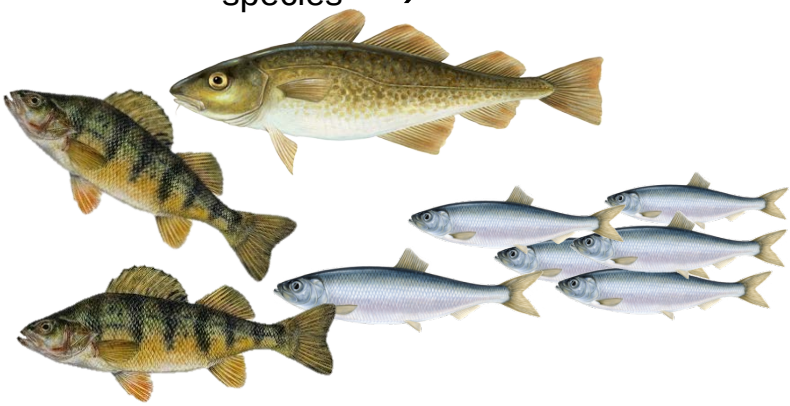
- Selection criteria
  - Available baseline organism
  - Multiple species (n≥3)

✓ Defined area in the Baltic Proper (BP, $n_{species}$=5)

✓ 2 stations on the West coast (WC1 and WC2, $n_{species}$=3)

➢ Evaluation based on

➢Mean Squared Error (MSE)



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Hg Concentrations

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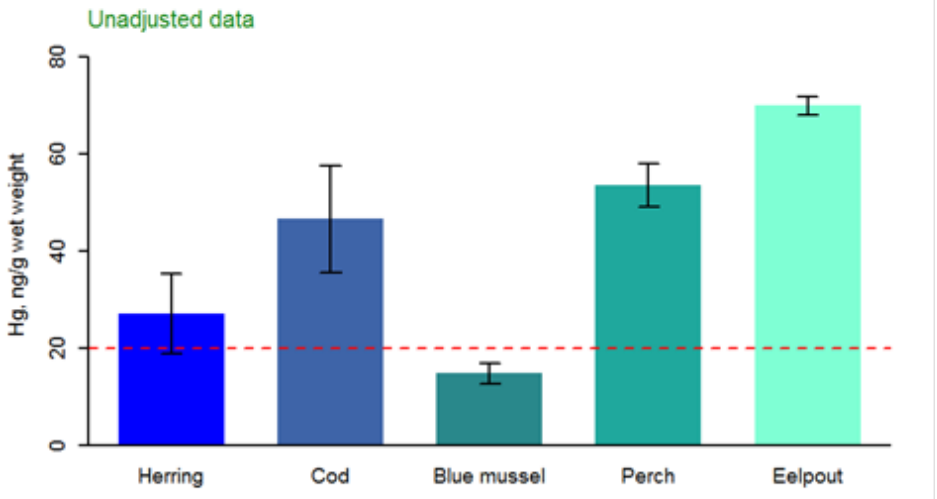

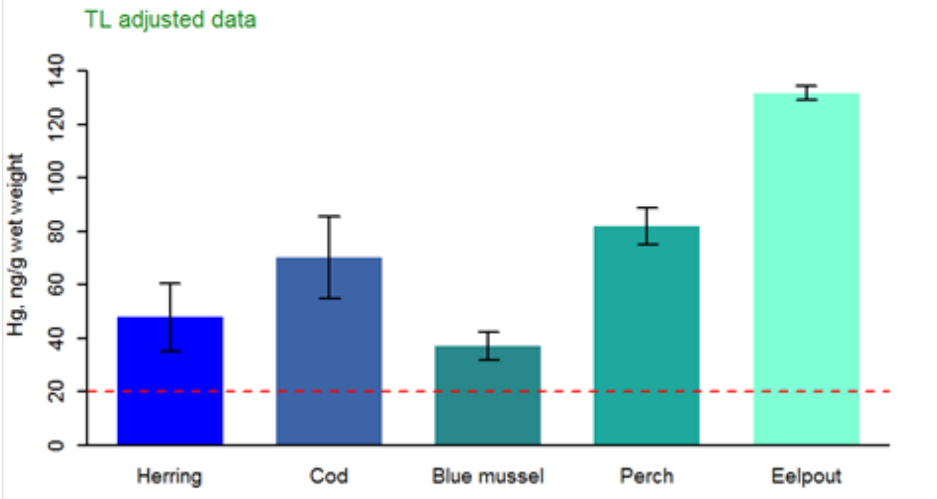

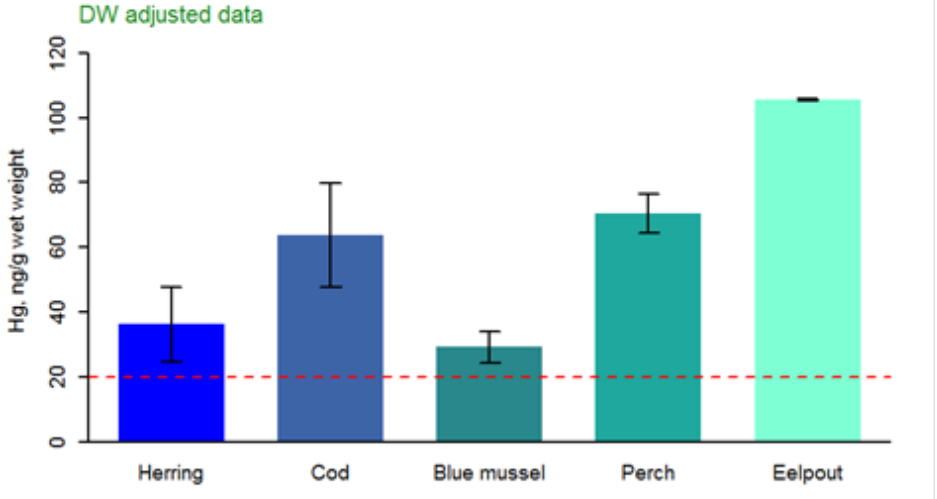

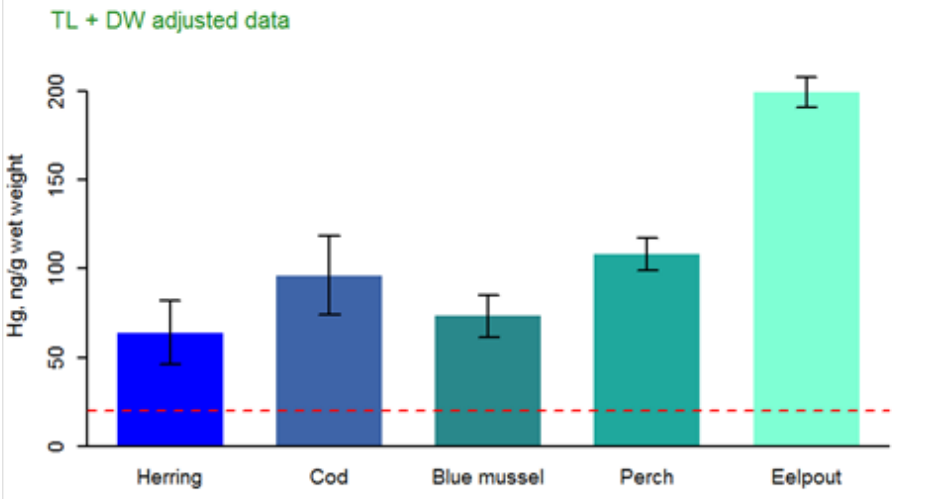

Interspecies variation: Baltic Proper

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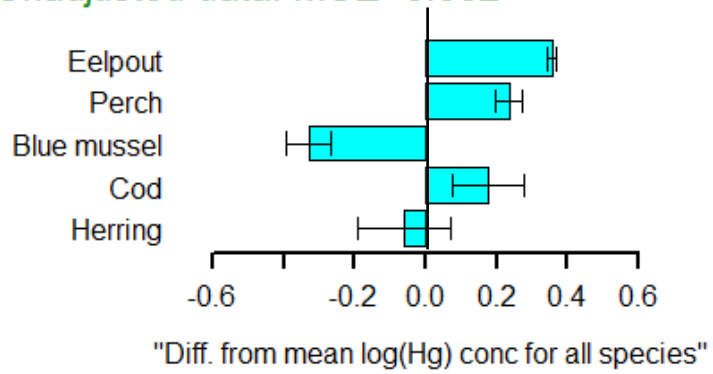
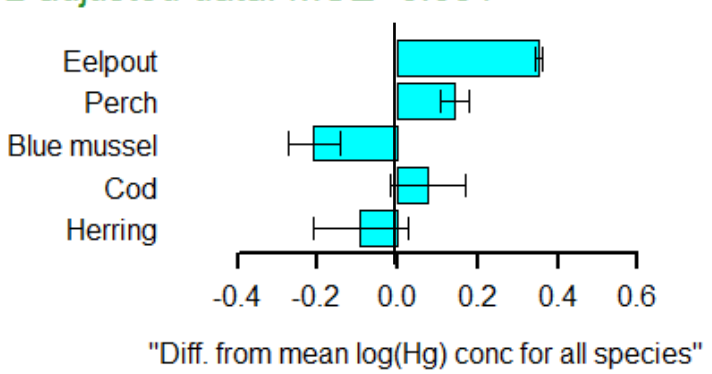
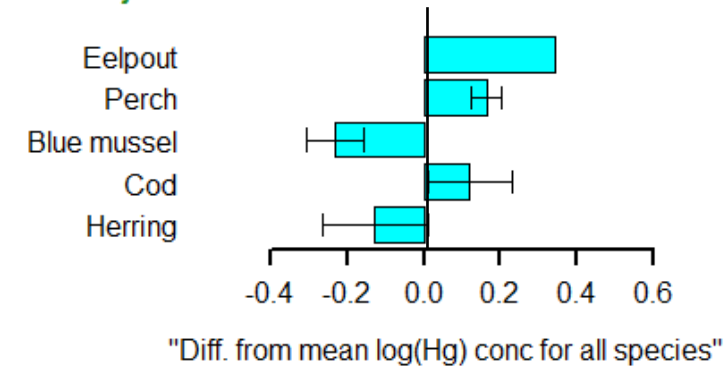
Unadjusted data: MSE=0.082



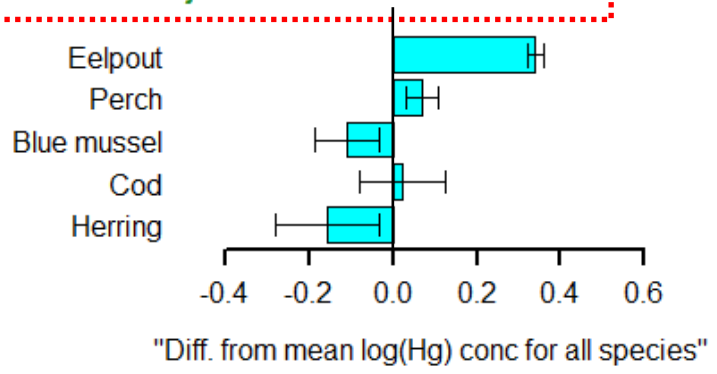
TL-adjusted data: MSE=0.051



DW-adjusted data: MSE=0.057



TL + DW-adjusted data: MSE=0.040



Intraspecies variation

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- Cod and Herring → reduced variation.
- Perch and Eelpout (and Blue mussel) → increased variation

Species [MSE]	Unadj.	TL+DW-adj.	Ratio
Cod	0.0055	0.0054	1.023
Herring	0.0092	0.0080	1.146
Perch	0.0004	0.0006	0.748
Eelpout	0.0001	0.0002	0.380
Blue mussel	0.0034	0.0036	0.969

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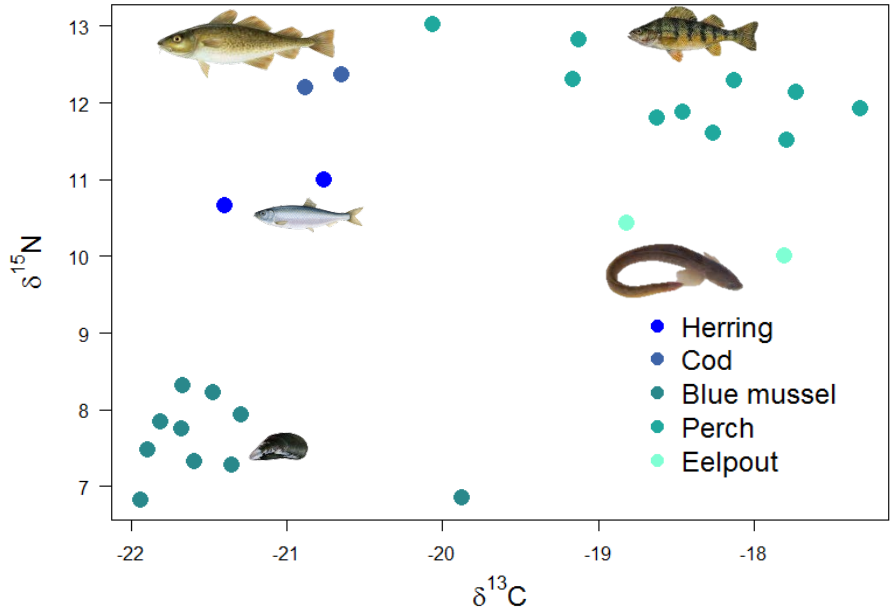

BP (– Eelpout and Perch)

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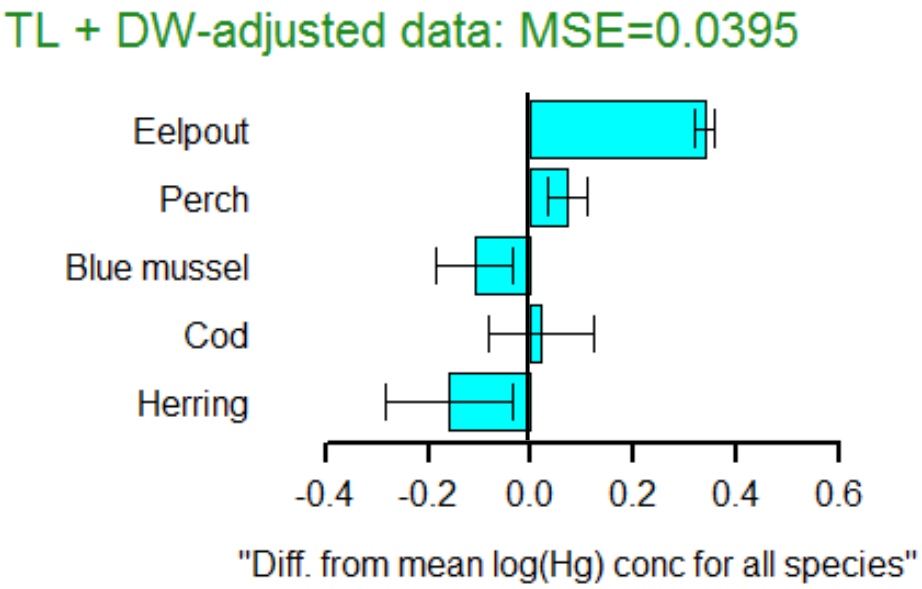
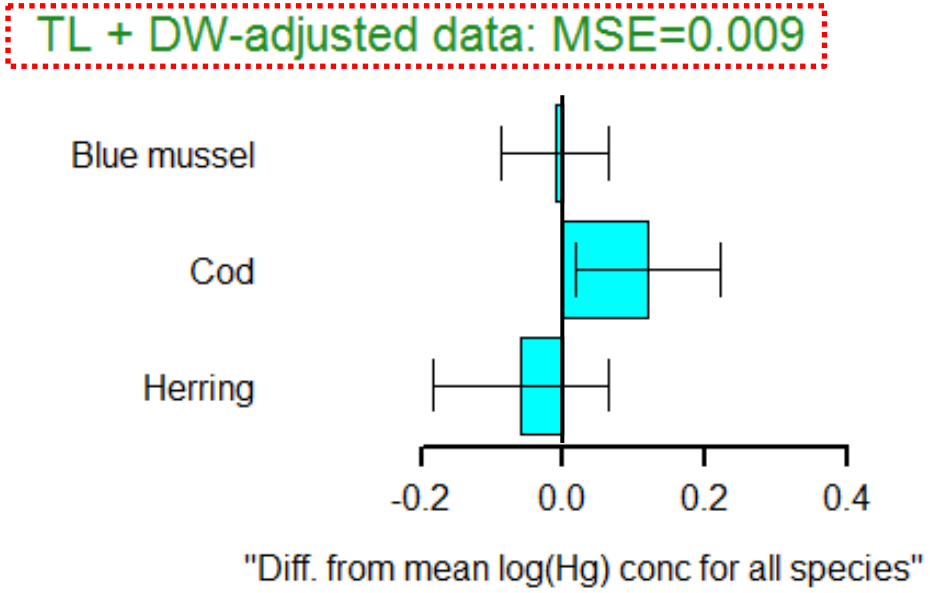
With Eelpout and Perch



Without Eelpout and Perch



Conclusions

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- TL adjustments reduced interspecies variation in Hg concentrations for 2/3 areas.
- TL+DW adjustment reduced intraspecies variation for only 2/5 species
- Inaccurate TP of species can result in wrongful concentrations wherefore knowledge of baseline data is crucial.

Thank you!

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- Acknowledgment
  - Thanks to the Swedish Environmental Protection Agency (Naturvårdsverket) for funding the Swedish Marine Contaminant Monitoring Programme (SMCMP).

NATUR VÅRDS VERKET